

University of Colorado

Breaking Barriers to 3D Printing

Part 1 of 3 in The Maker's Touch Webinar Series

Presented by Morris Huang, PhD

November 11, 2026

Center for Innovative Design and Engineering (CIDE)
UNIVERSITY OF COLORADO **DENVER | ANSCHUTZ MEDICAL CAMPUS**








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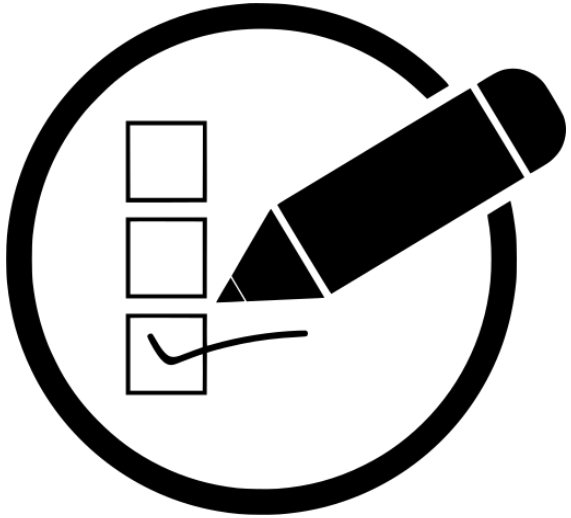
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Help me learn a bit about you

- Experience level with 3D printing?
- Experience with CAD or 3D modeling?
- Field of occupation?
- Serve/reside in rural or metro?



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Today's webinar agenda

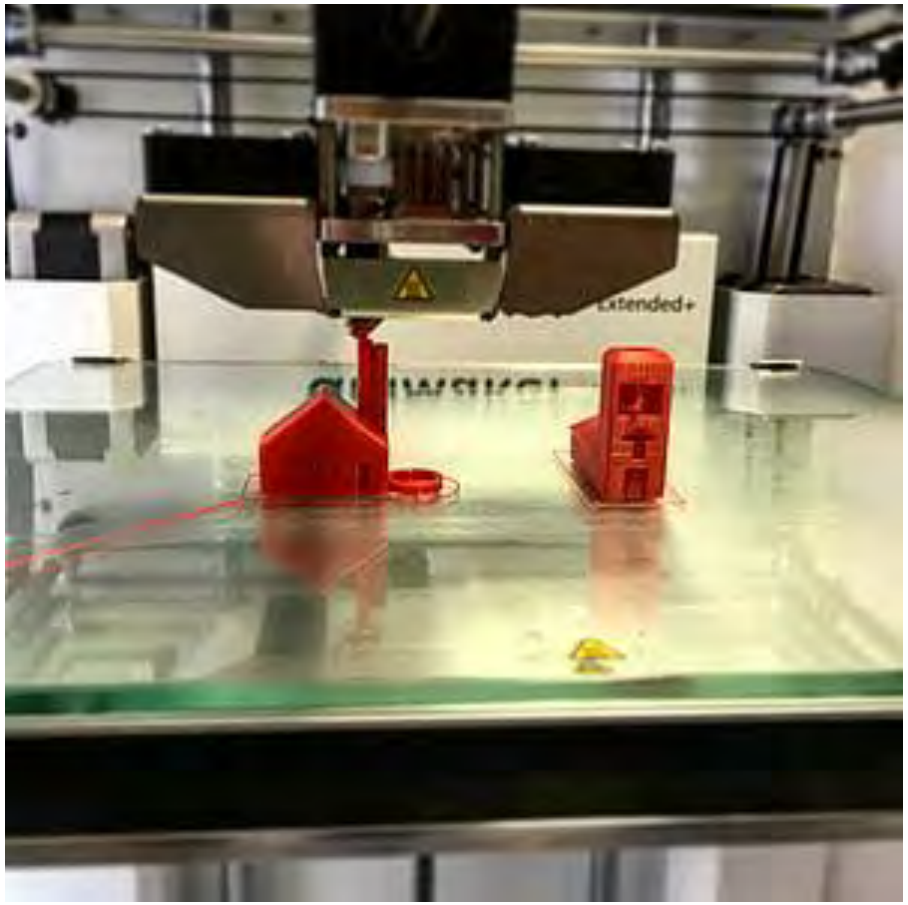
- Defining 3D printing
- Examples of 3D printing and success stories
- Tutorial and resources on how to do 3D printing
- Where and how to get printing materials and models
- Where and how to access 3D printers or 3D print services
- Entry-level 3D printers and fundings sources to acquire them
- Q&A
- Design tips and considerations when 3D printing AT [time-permitting]

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What is 3D printing?

3D printing is a fabrication method great for:

- Rapid prototyping
- Customization
- Medium-scale manufacturing
- Reducing material waste (*sometimes*)



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Examples of 3D printed AT solutions

These properties make it useful for assistive technology (AT) solutions:



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How we used to do 3D printing in clinic

Our center's engineers would print custom AT for clinic clients





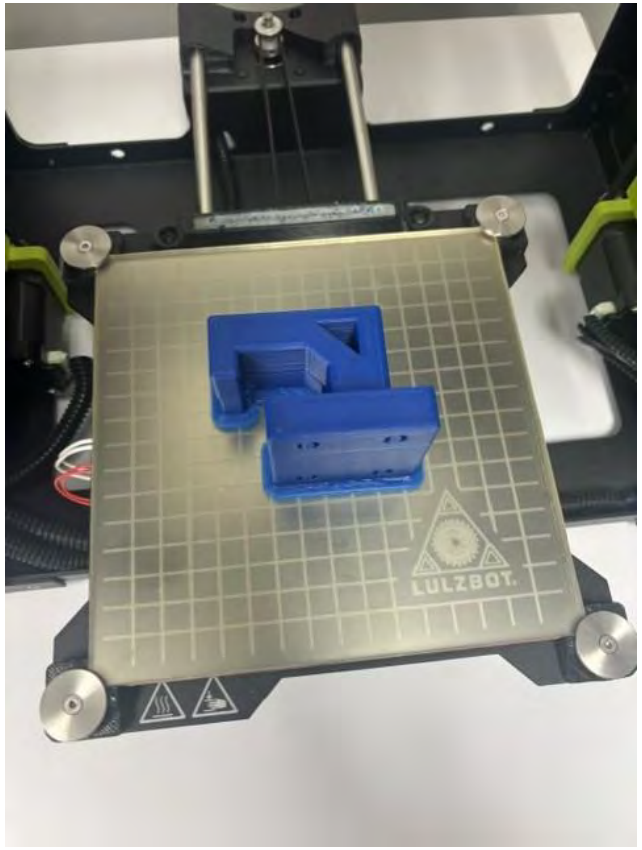




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How we now do 3D printing in clinic (1 of 3)

Our clinicians have been trained in the basics of 3D printing and now print most AT solutions in-house themselves





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How we <u>now do</u> 3D printing in clinic (2 of 3)





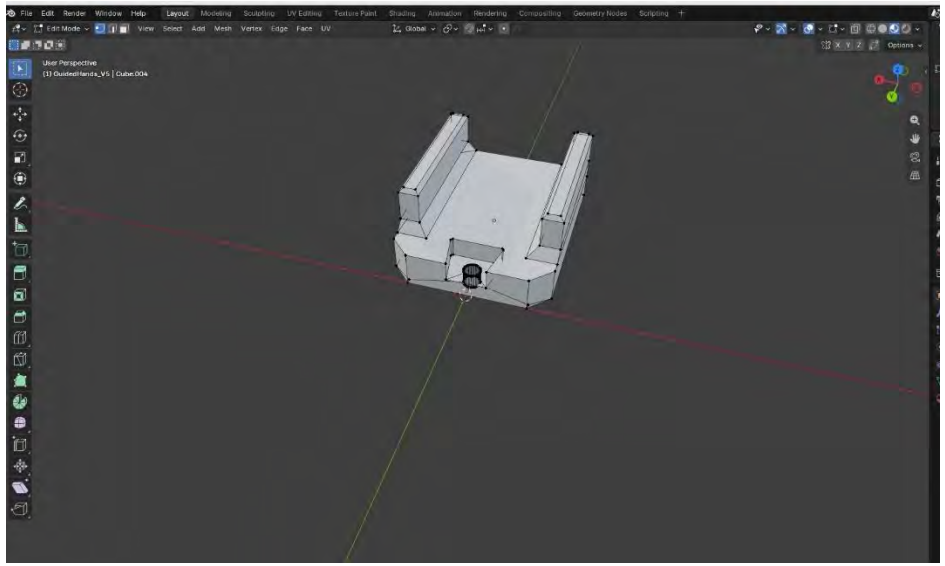


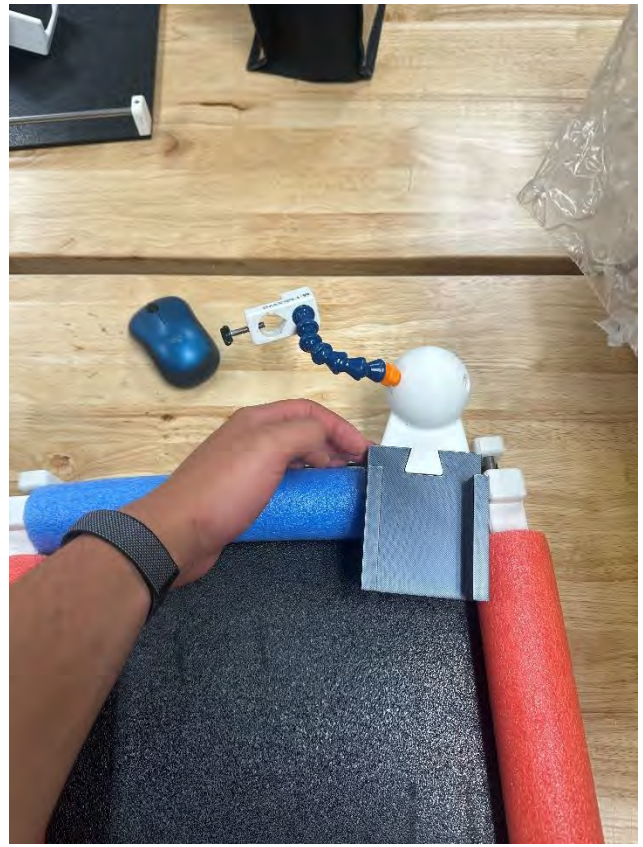


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How we now do 3D printing in clinic (3 of 3)

Our engineers and students do still help with maintaining and troubleshooting the printers, and redesign “off-the-shelf” print models that require more customization.



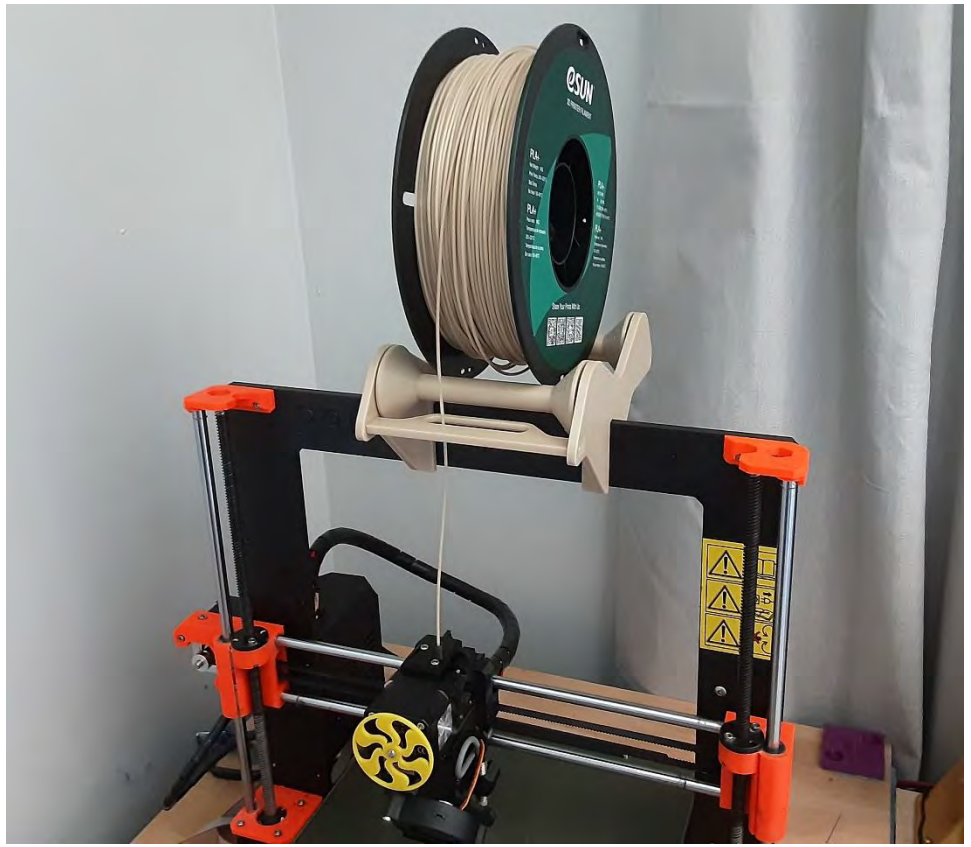


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Getting started with 3D printing (1 of 2)

To get started with 3D printing, you will need:

- **A 3D printer**
- **3D printing filament**
- A 3D model file
- A compatible slicer



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Getting started with 3D printing (2 of 2)

To get started with 3D printing, you will need:

- A 3D printer
- 3D printing filament
- **A 3D model**
- **A compatible slicer**



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How about I give you a live demo?

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Important printing settings (and tips)

- Nozzle temperature
- Bed temperature
- Adhesion settings
- Layer thickness
- Infill percentage & pattern
- Print orientation
- Supports

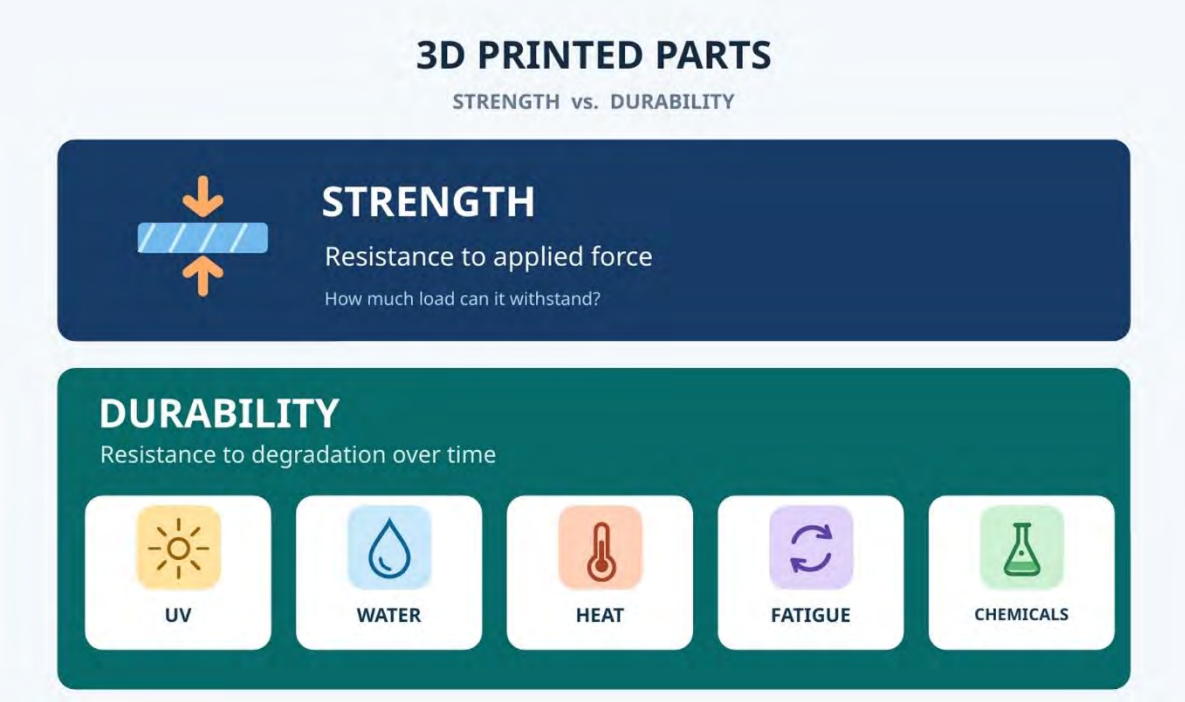


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Selecting 3D print filament types (1 of 2)

- PLA
  - lowest cost, strongest but least durable
- PETG
  - food grade (best with food-grade epoxy sealing)
- TPU
  - flexible applications, can be difficult to print
- ABS
  - lowest cost, strong and durable
- ASA
  - most durable (highly UV and water resistant)



created with ChatGPT EDU

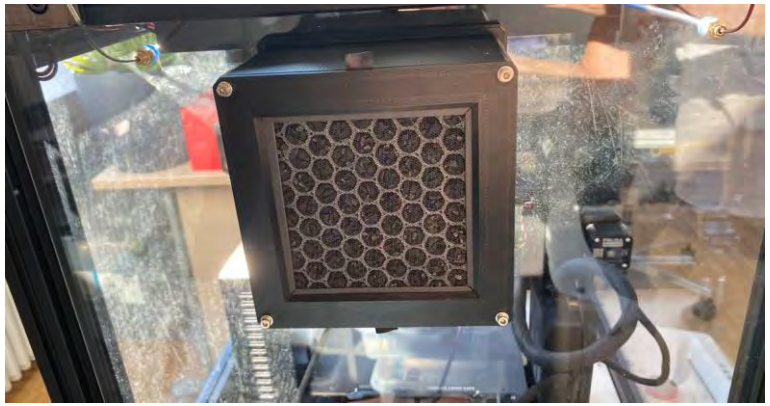
https://www.simplify3d.com/resources/materials-guide/; https://www.simplify3d.com/resources/materials-guide/properties-table/

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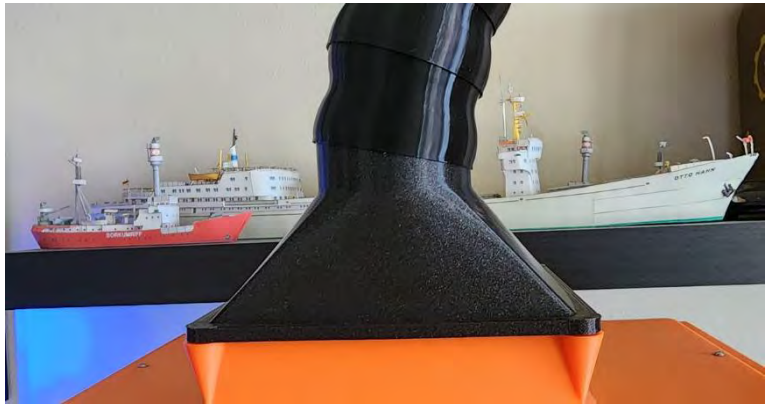
Selecting 3D print filament types (2 of 2)

- PLA
  - low risk fumes/particles, ventilation recommended
- PETG
  - low-medium risk fumes/particles, ventilation recommended
- TPU
  - low-medium risk fumes/particles, ventilation recommended
- ABS
  - high risk fumes/particles, ventilation **required**
- ASA
  - high risk fumes/particles, ventilation **required**

https://www.3dtechvalley.com/3d-printer-ventilation/



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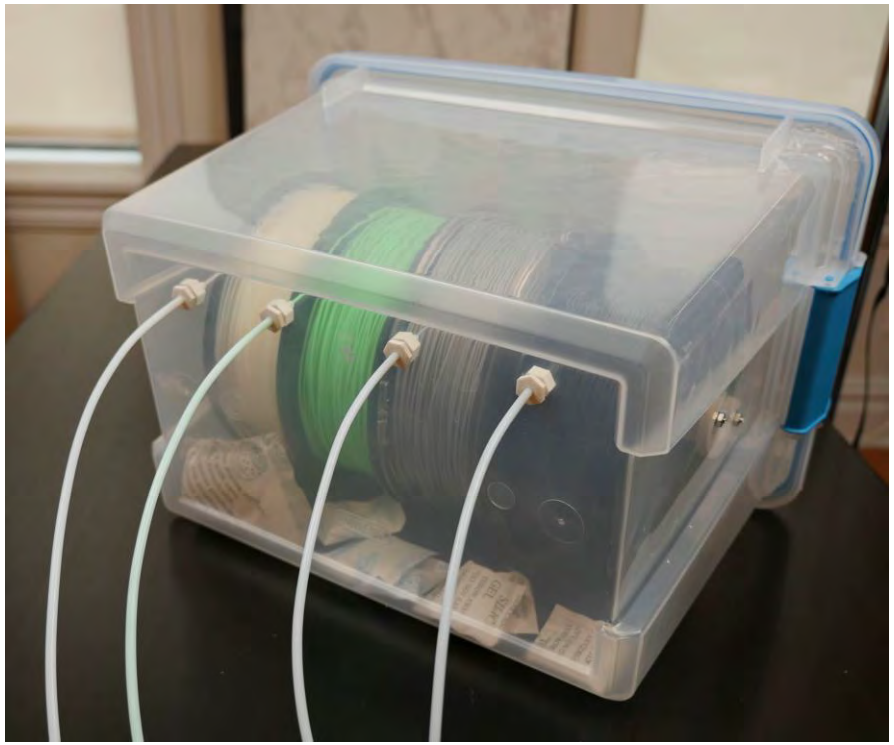


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Where to purchase 3D print filament

- Premium (most reliable)
  - Polymaker
  - Prusament
  - Bambu
- Value (budget-friendly)
  - Hatchbox
  - Elegoo
  - eSUN



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https://sigmafilament.com/best-3d-printer-filament-brand/; https://www.tomshardware.com/best-picks/best-filaments-for-3d-printing

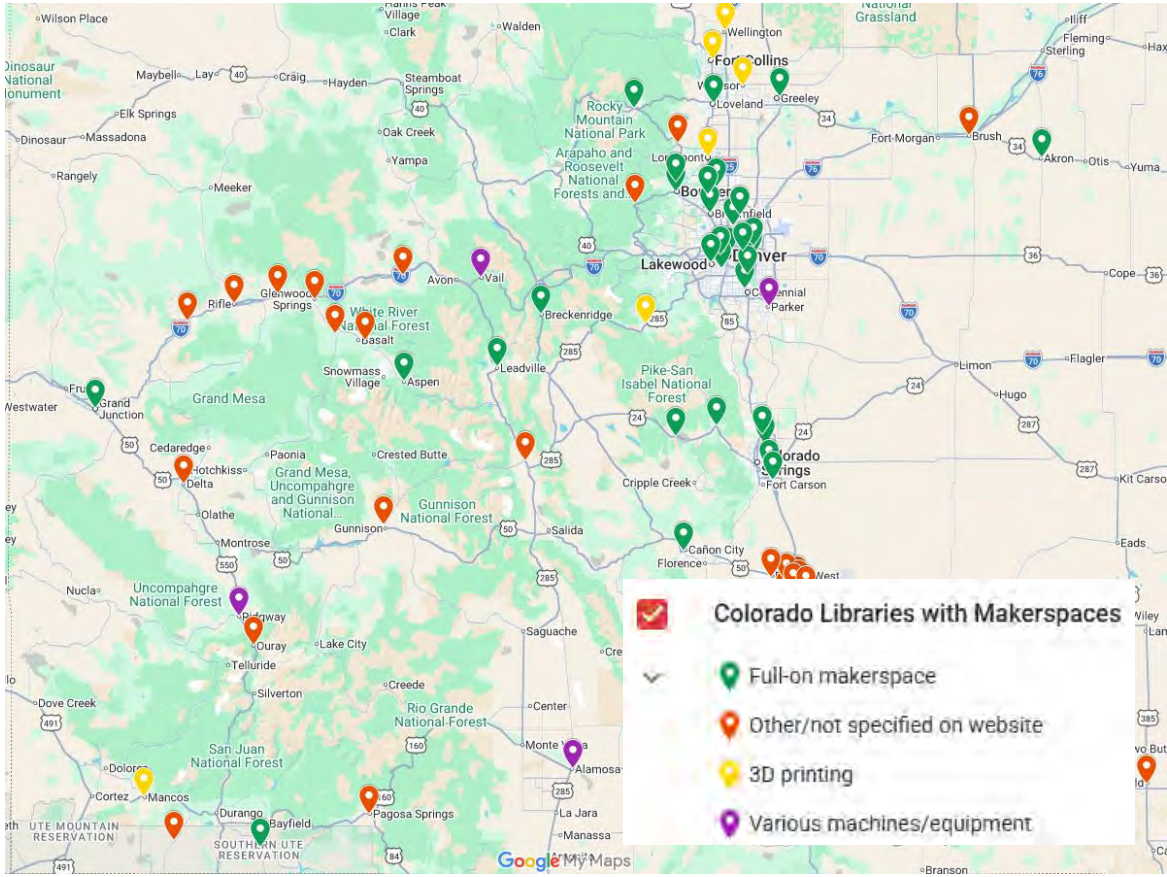
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How to access 3D printers

- Public libraries
  - Pay for filament – Pikes Peak Library District
  - Free printing – Denver (ideaLABs)
  - No library card needed – Broomfield

  ** Larger prints may cost $ or not be possible*

  *** May require scheduling and/or training*
- Universities
  - CSU Idea2Product Lab (K-12 free)
- Membership-based makerspaces



https://www.coloradovirtuallibrary.org/resource-sharing/colorado-libraries-with-makerspaces/

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3D print services – pickup or delivery

- Public libraries
  - Arapahoe Libraries (free)
- Commercial (local)
  - The 3D Printing Store (3DPS) – Denver-based
  - Revamp3D – Denver-based, serves, Aurora, Lakewood, Front Range
- Commercial (anywhere)
  - Craftcloud – often most competitive prices
  - PCBWay – competitive shipping prices
  - Shapeways – flat rate per part

https://all3dp.com/2/best-cheap-3d-printing-services/

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Entry-level 3D printers







- Creality Ender-3 V3 SE – $199
  - 220 x 220 x 250 mm; reliable beginner 3D printer
- Bambu Lab A1 Mini – $220
  - 180 x 180 x 180 mm; most compact size
- Anycubic Kobra X – $299
  - 260 x 260 x 260 mm; can do 4-color prints
- Bambu Lab A1 – $320
  - 256 x 256 x 256 mm; fast setup and can expand to 4-colors
- Flashforge Adventurer 5M Pro – $529
  - 220 × 220 × 220 mm; enclosed with HEPA and activated carbon filter

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Funding resources to acquire 3D printers

- LOR foundation
- Colorado Creates grant
- Denver Foundation
- MakerBotGivesBack



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Where to find 3D print models?

Many options but AT may not always be easily searchable (try “adaptive”, “aid”, and filter by “healthcare”)

- Printables
- MakerWorld
- Thingiverse
- Cults3D
- Thangs

https://3dprinting.com/3d-models/best-free-3d-printable-models/;
https://access3d.org/devices





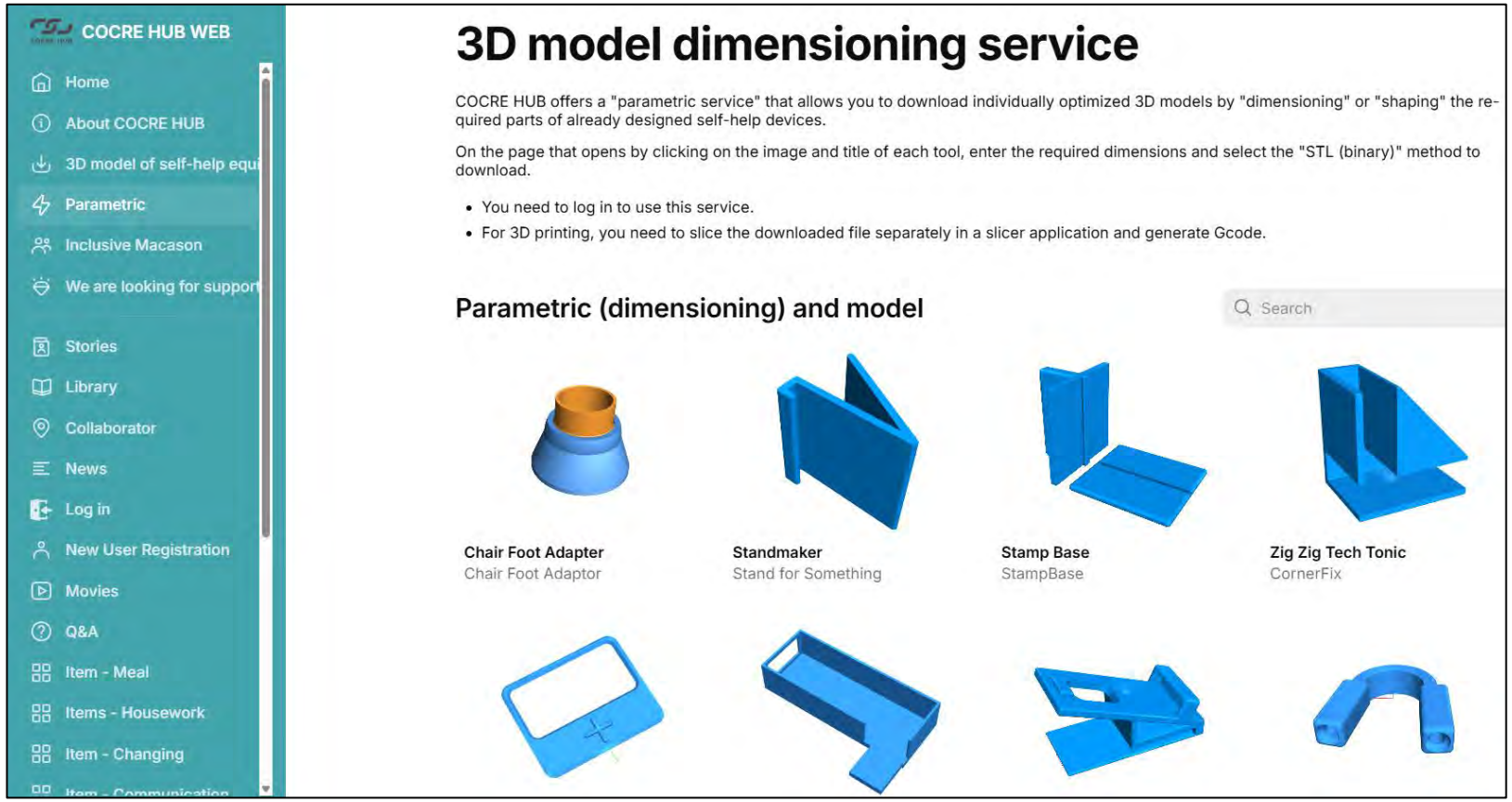




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Customizing 3D print models without CAD

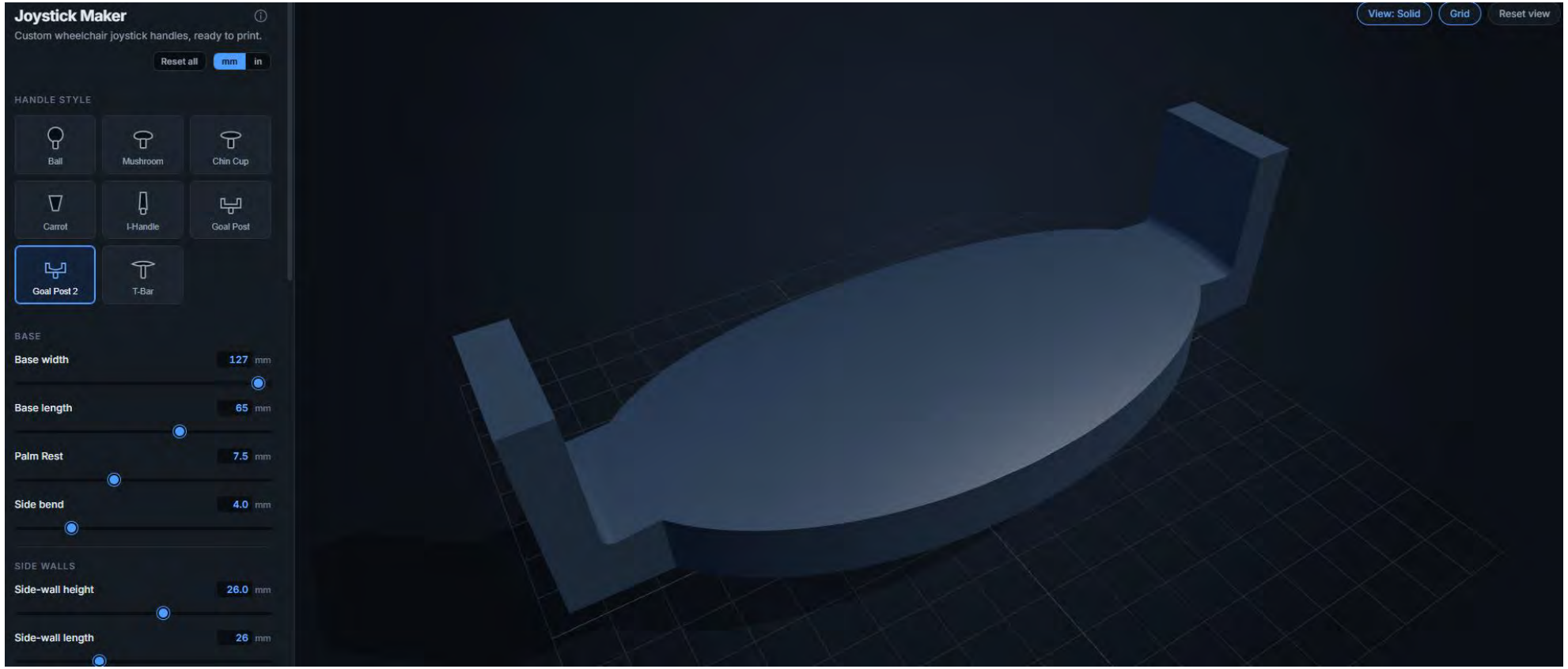
Parametric 3D models are needed!



https://cocrehub.com/dl/6471c6 [Have to “right-click” and translate pages to English in browser!]

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One more success story



https://wheelchair-joystick-maker.vercel.app/

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Let’s check on our 3D print!

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Important printing settings (and tips)

- Nozzle temperature
- Bed temperature
- Adhesion settings
- Layer thickness
- Infill percentage & pattern
- Print orientation
- Supports

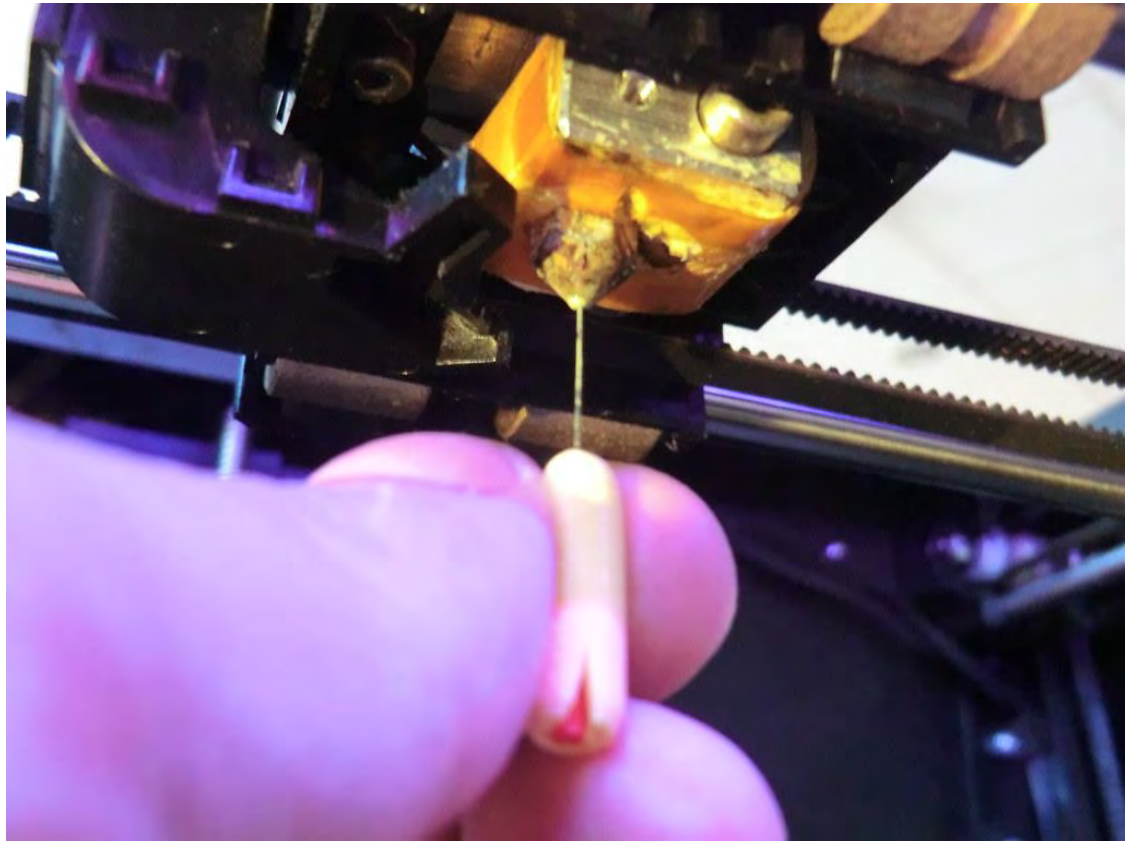


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Nozzle temperature

- Nozzle temperature is dependent on the temperature to sufficiently melt the filament
- This spec can typically be found on the filament spool but may require some trial & error

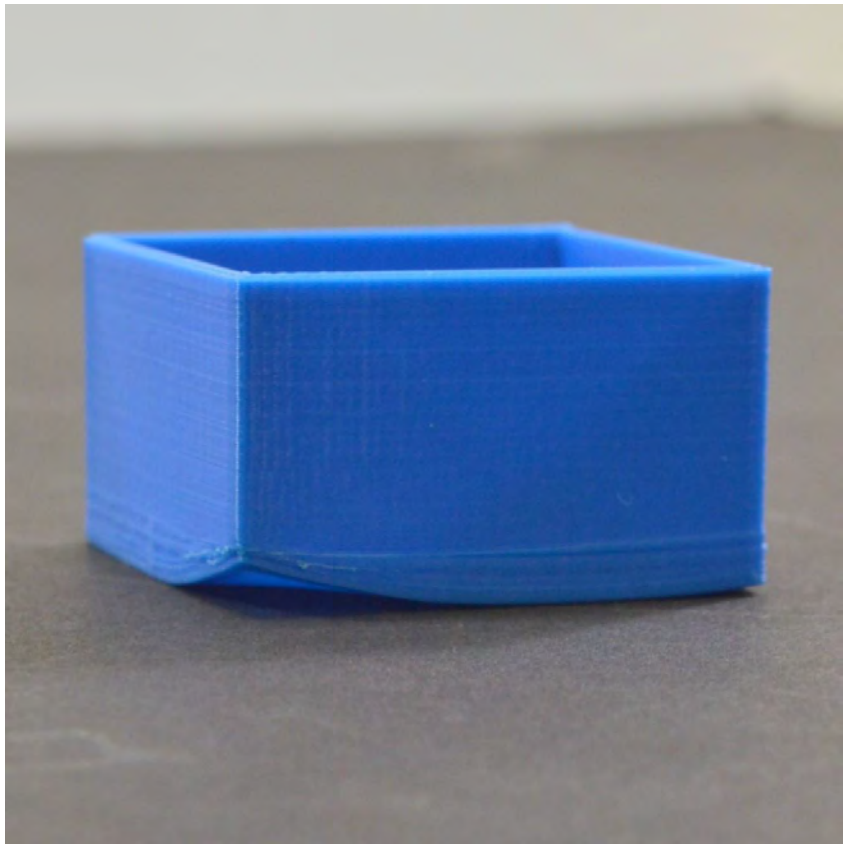


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Bed temperature

- Bed temperature is also filament dependent to prevent warping and promote bed adhesion
- Can also typically be found detailed on the filament spool



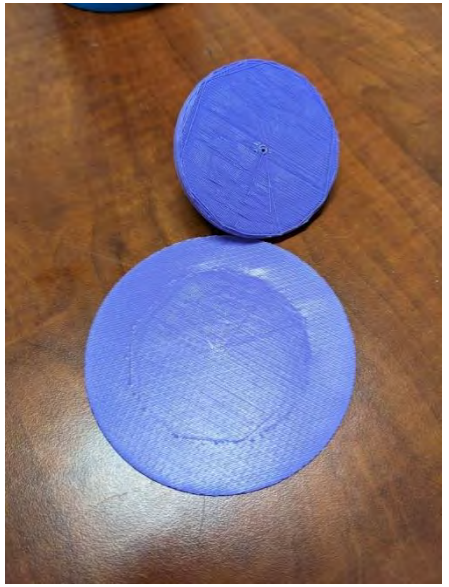
This Photo from Simplify3D.com

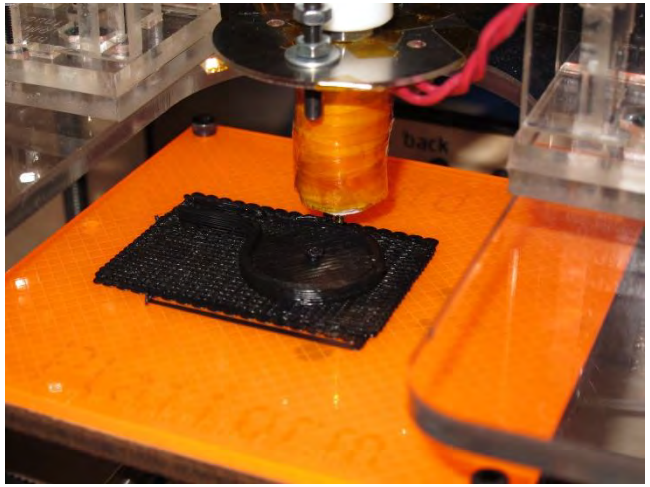
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Adhesion settings

- Adhesion settings help make sure your print adheres to the bed properly
- From least to strongest
  - Skirt (Outlines)
  - Brim (1-layer base)
  - Raft (Multi-layer base)



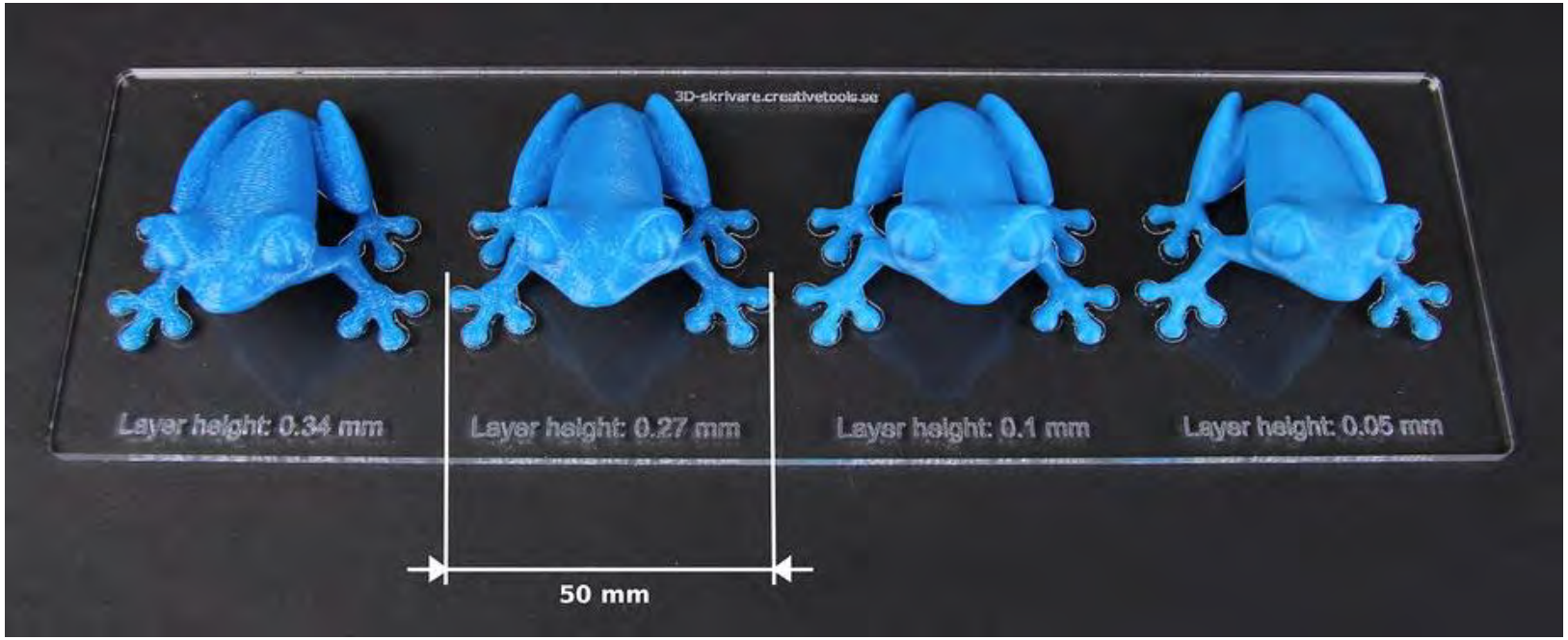




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Layer thickness

- This impacts your surface detail, or finish; thinner = finer detail
- Medium layer thickness/height (0.15 – 0.25mm) gives the bed adhesion

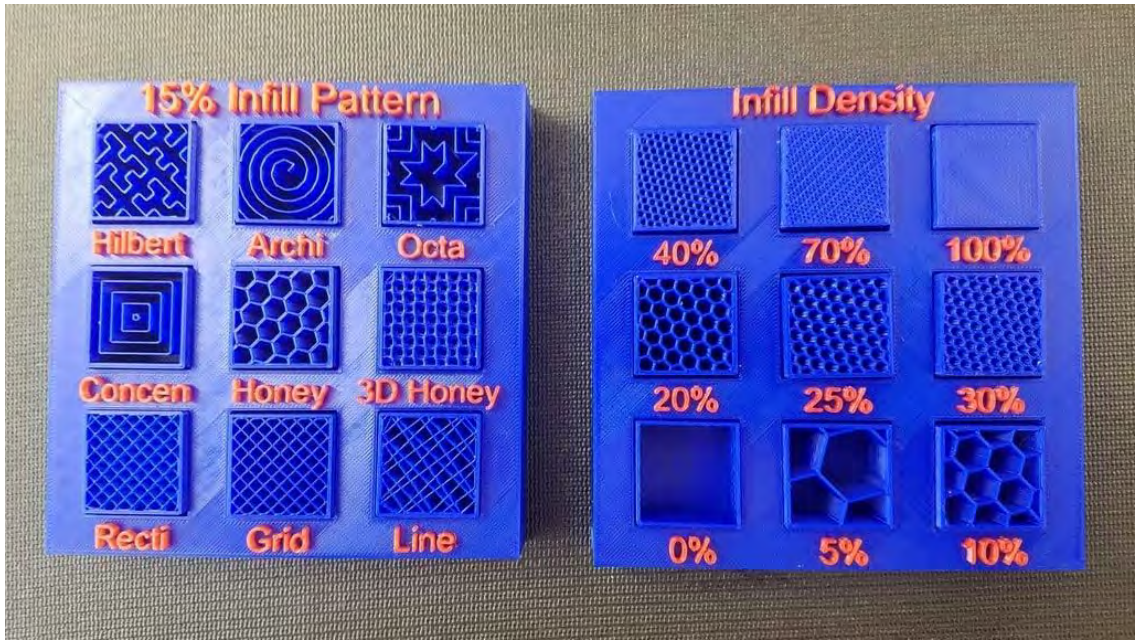


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Infill percentage & pattern

- Infill percentage is a key factor in strength…up to a point
- 20-40% is generally functional
- 40-100% is for load-bearing
- Cubic, gyroid, and triangle patterns are usually strongest



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Print orientation

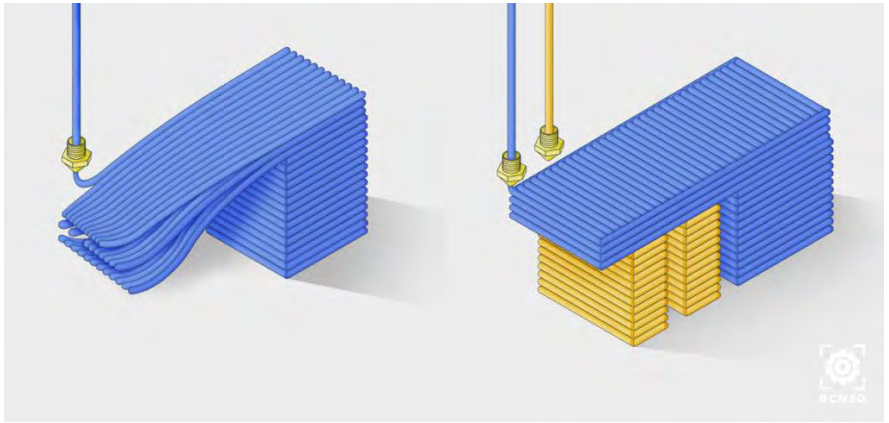
- Print orientation depends on how you position the model on the slicer
- Most relevant if bending and shear stresses are involved



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Supports

- Enabling supports prevents overhanging features from “drooping” and deforming
- Supports can be a challenge to remove and clean up the contact surface afterwards



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A few last 3D print tips

- If you are printing a part with holes, you may need redrill them to the intended size
- Adding more wall layers also makes the holes more stable (and adds to the overall model strength as well)



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